Glossary of GPS Terminology

Acquisition Time
The time it takes for your GPS unit to acquire a lock onto enough satellites (three for a 2D and four for a 3D) position fix.

Active from waypoint
The user's starting point, or the receiver's last stored waypoint.

Active Leg
The segment of a route currently being traveled.

Active to waypoint
The user's desired destination, whether in an active route, or as a single waypoint.

Almanac Data
Constellation information (including location and health of satellites) transmitted by each satellite and collected by a GPS receiver. Almanac data allows a receiver to acquire satellite signals as soon as it is turned on.

Anti-spoofing
Encryption of the P-code signal from GPS satellites so that only authorized users may have access to the corrected signal.

Availability
The percentage of time that the services of NAVSTAR GPS can be used within a particular coverage area at a particular time.

Azimuth
The angle of measurement between one point and another point. Angular horizontal direction, measured in degrees clockwise around a circle, where the value indicates 1/360th of a circle (degrees) where 0° is North, 90° is East, 180° is South, and 270° is West, and 360° is also North. An azimuth is comprised of two rays, one which extends to true north from point one, and the other from point one to point two. The azimuth from pt. 2 back to pt. 1 is called a "back azimuth." A bearing is <u>not</u> an azimuth, even though GPS receivers usually refer to an azimuth as a bearing. If your GPS gives you a bearing of 330^0, this is an azimuth. The bearing would actually be stated as $N30^0W$. See Bearing.

Bearing (BRG)
The compass direction, as a variance of north or south, from your position to a destination, measured to the nearest degree. A bearing is an angular horizontal direction, measured either clockwise or counter clockwise around one-fourth of a circle, where the value is in degrees relative to either north or south. Written N30°E (Azimuth = 30°), S25°E (Azimuth = 165°), etc. Bearing is commonly misused in place of azimuth. In a GPS receiver bearing refers to the direction to a waypoint. See Azimuth and Heading.

Block I, II, IIR, IIF satellites
The various generations of GPS satellites: Block I were prototype satellites that began being launched in 1978; 24 Block II satellites made up the fully operational GPS constellation declared in 1995; Block IIR are replenishment satellites; and Block IIF refers to the follow-on generation.

C/A Code (Course Acquisition Code)
The standard civilian GPS code - which is subject to degradation by Selective Availability. The code is used by receivers to perform rough navigation calculations. The coarse/acquisition or clear/acquisition code modulated onto the GPS L1 signal. This code is a sequence of 1023 pseudorandom binary biphase modulations on the GPS carrier at a chipping rate of 1.023 MHz, thus having a code repetition period of 1 millisecond. The code was selected to provide good acquisition properties. Also known as the "civilian code."

Carrier
A radio wave having at least one characteristic, such as frequency, amplitude or phase, that may be varied from a known reference value by modulation.

Carrier-aided tracking
A signal processing strategy that uses the GPS carrier signal to achieve an exact lock on the pseudorandom code.

Carrier frequency
The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.

Carrier phase
GPS measurements based on the L1 or L2 carrier signal.

Cartesian coordinates
Coordinates that are defined by their linear distance along two (x, y) or three axes (x, y, z) that form right angles. Two axes are used for the familiar two-dimensional paper grid. Three axes are used for three-dimensional space.

Channel
A channel of a GPS receiver consisting of the circuitry necessary to receive the signal from a single GPS satellite. Multi-channel receivers allow continuous signal acquisition of multiple satellites simultaneously.

Circular error probable (CEP)
In a circular normal distribution, the radius of the circle containing 50 percent of the individual measurements being made, or the radius of the circle within which there is a 50 percent probability of being located.

Clock correction
Defines the precise time of satellite signal transmission. It is included as part of the satellite signal message.

Code phase GPS
GPS measurements based on the C/A code.

Cold Start
Powering up a GPS receiver after it has been turned off for an extended period of time. It may no longer contain current ephemeris and almanac data.

Control Segment
A world-wide chain of monitoring and control stations that ensure the accuracy of GPS satellite clocks and their positions.

Coordinates
A unique description of a geographic position using numeric or alphanumeric characters.

Course
The direction from the beginning landmark of a course to its destination (measured in degrees, radians, or mils).

Course Made Good (CMG)
The bearing from the 'active from' position (your starting point) to your present position.

Course Over Ground (COG)
Your direction of movement relative to a ground position.

Course To Steer
The heading you need to maintain in order to reach a destination.

Crosstrack Error (XTE/XTK)
The distance you are off the desired course in either direction. The amount of perpendicular distance a receiver is away from a course between two waypoints. Usually expressed in a GPS receiver through a Course Deviation Indicator (CDI).

Data Message
An electronic message giving a satellite's location, clock corrections and health included in the GPS signal received from each satellite.
It's a message included in the GPS signal, which reports the satellite's location, clock corrections and health. Included is information about the other satellites in the constellation. (See Almanac, and Ephemeris.)

Datum
A reference system used to describe the surface of the earth. Every coordinate system is linked to a specific datum.

Degree
A unit of measurement equal to 1/360 part of the circumference of a circle. One degree has 60 minutes (which has 60 seconds).

Desired Track (DTK)
The compass course between the "from" and "to" waypoints.

Differential GPS (DGPS)

A technique used to improve positioning or navigation accuracy by determining the positioning error at a known location and subsequently incorporating a corrective factor (by real-time signal transmission of corrections or by computer post processing) into the position calculations of another receiver operating in the same area and simultaneously tracking the same satellites.

Dilution of Precision - DOP
A description of the purely geometrical contribution to the uncertainty in a position fix. Standard terms for the GPS application are: GDOP: Geometric (3 position coordinates plus clock offset in the solution) PDOP: Position (3 coordinates) HDOP: Horizontal (2 horizontal coordinates) VDOP: Vertical (height only) TDOP: Time (clock offset only) RDOP: Relative (normalized to 60 seconds). A multiplicative factor caused by geometry that modifies ranging between the user and his set of satellites. Also referred to as GOP or GDOP.

Distance To Waypoint
A measurement in statute/nautical/or metric increments from your current position to your current destination waypoint.

Dithering
The introduction of digital noise. This is the process the DOD uses to add inaccuracy to GPS signals to induce Selective Availability.

Doppler-aiding
A signal processing strategy that uses a measured doppler shift to help the receiver smoothly track the GPS signal. Allows more precise velocity and position measurement.

Doppler shift
The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver.

Earth Centered Earth Fixed (ECEF)
A Cartesian coordinate system used exclusively by GPS, where the origin is the center of the earth, and the axes are tied to specific latitude/longitude coordinates. It is comprised of *x*, *y*, and *z* axes where the x axis is the intersection of the east meridian and the equator, the y axis goes through the north pole, and z goes through the intersection of the prime meridian and the equator (the direction of the spin axis). The vectors rotate with the earth. ECEF is a distortion-free computer based coordinate system, and is not found on any maps.

Ellipsoid
A slightly flattened sphere (the earth) that can be described with a mathematical formula. In other words, it's a mathematical portrayal of the earth's surface. See Geoid.

Ephemeris
Current and accurate satellite position data provided as a function of time, and transmitted as part of the satellite data message.

Estimated Position Error (EPE)
A measurement of horizontal position error in feet or meters based upon a variety of factors including DOP and satellite signal quality.

Estimated Time Enroute (ETE)
The time left to your destination based upon your present speed and course.

Estimated Time of Arrival (ETA)
The time of day of your arrival at a destination.

Geocoding
The process of assigning an absolute location (as *x*, *y* coordinates) to a geographic feature referenced by a relative location, such as a street address or zip code.

Geoid
The particular equipotential surface that coincides with mean sea level and that may be imagined to extend through the continents. See Ellipsoid.

Geometric Quality
The probable accuracy of a position fix found by taking into consideration the relative position of satellites.

Global Positioning System (GPS)
The U.S. Department of Defense Global Positioning System: A constellation of more than 24 satellites orbiting the earth at a very high altitude. GPS satellites transmit signals that allow a GPS receiver to determine, with great accuracy, their. The receivers can be fixed on the Earth, in moving vehicles, aircraft, or in low-earth orbiting satellites. GPS is used in air, land and sea navigation, mapping, surveying and other applications where precise positioning is necessary. See NAVSTAR GPS.

GOTO
A GPS receiver function consisting of a one leg route with your present position being the start of the route and a single defined waypoint as the destination.

GPS ICD-200
The GPS Interface Control Document is a government document that contains the full technical description of the interface between the satellites and the user.

Graticule
The lines of latitude and longitude on a map.

Grid
Parallel lines on map that represent a rectangular coordinate system (such as UTM). Grid and graticule represent the same thing but for different coordinate systems.

Grid north
The direction that a north-south grid line points in a rectangular coordinate system. In UTM, grid north does not deviate more than 3° from true north. It is defined on maps as east or west of true north, by X number of degrees.

Ground track
Also ground speed. Accurate speed and direction of travel information provided by a GPS receiver.

Handover word
The word in the GPS message that contains synchronization information for the transfer of tracking from C/A to P -code.

Heading
The direction of intended movement. It is the horizontal direction you are facing or traveling.

I/O (Interface Option)
The one-way or two-way transfer of GPS information with another device, such as a navigation plotter, autopilot, or another GPS unit.

Initialization
The first time a GPS receiver orients itself to its current location. After initialization has occurred, the receiver remembers its location and acquires a position more quickly because it doesn't need a large amount of satellite information. See Cold start.

Invert Route
To display and navigate a route from end to beginning for purposes of returning back to the route's starting point.

Ionospheric refraction
The change in the propagation speed of a signal as it passes through the ionosphere.

L-band
The group of radio frequencies extending from 390 MHz to 1550 MHz. The GPS carrier frequencies (1227.6 MHz and 1575.42 MHz) are in the L-band.

L1 signal
The primary L-band signal transmitted by each GPS satellite at 1572.42 MHz. The L1 broadcast is modulated with the C/A and P-codes and with the navigation message.

L2 signal
The second L-band signal is centered at 1227.60 MHz and carries the P-code and navigation message.

Latitude
A point's distance north or south of the equator measured by degrees from 0 to 90. A line of latitude is a parallel. See longitude.

Latitude and longitude
A global coordinate system using angular measurements to determine positions on the earth. See latitude. See longitude.

Leg (route)
A portion of a route consisting of a starting (from) waypoint and a destination (to) waypoint. A route that is comprised of waypoints A, B, C, and D would contain three legs. The route legs would be from A to B, from B to C, and from C to D.

Longitude
A point's distance east or west of the prime meridian (measured in degrees) which runs from the North Pole to the South Pole through Greenwich, England. A line of longitude is called a meridian. See latitude.

Map
A map is a two-dimensional representation of the earth's sphere. Projecting the earth's three-dimensional surface onto sheets of paper subjects all planar maps to some spatial distortion. The type and extent of distortion depends on the projection and scale used to produce the map.

Map Projections
The formulas that convert one coordinate system to another (for example, lat/long to UTM).

Metes & Bounds
A common method of land division in the eastern U.S. It's a system of establishing boundaries of tracts of land by reference to natural or artificial monuments along it. Compare it to the Public Land Survey System (PLSS) used in the western U.S., and established by beginning at a fixed reference point.

Mil
A unit of measurement equal to 1/6400 part of the circumference of a circle. It can be found in the legend of USGS quadrangle maps as a measure of variance from true north.

Military Grid Reference System (MGRS)
A system that uses standard-scale grid square, based on a point of origin on a map projection of the earth's surface in an accurate and consistent manner to permit either position referencing or the computation of direction and distance between grid positions. A position is described by a series of numbers and letters to describe a grid zone, a 100,000 meter square, and a distance to the east followed by a distance to the north both measured from the coordinate origin of the square (typically the lower left corner).

Modem
A modulator/demodulator. When two computers communicate over telephone lines and similar media, digital signals must be converted to analog during transmission, then back again to digital at the destination. Modems are always used in pairs, one at each end. They are rated according to the speed, typically in "bits per second," at which the information can pass through the transmission medium.

Multichannel receiver
A receiver containing multiple independent channels, each of which tracks one or more satellites continuously, so that position solutions are derived from simultaneous calculations of pseudo-ranges. A five channel receiver can track five satellites continuously, but must disconnect from one or more of those satellites to track more than five at one time. A twelve channel receiver is capable of tracking most or all satellites visible at any time in a quadrant of the sky. Most receivers today are twelve channel, though some high-end receivers are not.

Multipath
Interference caused by reflected GPS signals arriving at the receiver, typically as a result of nearby structures or other reflective surfaces. Signals traveling longer paths produce higher (erroneous) pseudo-range estimates and, consequently, positioning errors.

Multipath Error
An error caused when a signal reaches the receiver antenna by more than one path. Usually caused by one or more paths being bounced or reflected off objects such as buildings, cars, towers, etc.

NAD27
North American Datum of 1927. The datum used on most large scale USGS topographic maps.

NAD83
North American Datum of 1983. A newer datum used on maps produced more recently in the U.S. Almost identical to WGS84. See WGS84.

Nanosecond
One billionth of a second. GPS time is measured in nanoseconds.

Navigation
The act of determining the course or heading of movement.

Navigation message
The 1500-bit navigation message broadcast by each GPS satellite at 50 bps on the L1 and/or L2 signals. This message contains system time, clock correction parameters, ionospheric delay model parameters, and the vehicle's ephemeris and health. The information is used to process GPS signals to give the GPS user time, position, and velocity.

NAVSTAR GPS

Navigational Satellite Timing And Ranging Global Positioning System, as named by the U.S. Department of Defense, and referred to simply as "GPS."

Neatline
The lines that border the face of a map. Separates the map face from the margins. On quadrangle maps, such as 7.5 minute and 15 minute, the neatlines correspond to lines of latitude and longitude (graticules).

P-Code
A code used by precise positioning GPS receivers to perform precise navigation calculations. Used by the military.

The precise or precision code of the GPS signal, typically used alone by U.S. and allied military receivers. A very long sequence of pseudo-random binary biphase modulations on the GPS carrier at a chip rate of 10.23 MHz which repeats about every 267 days. Each one-week segment of this code is unique to one GPS satellite and is reset each week.

PDOP - Position dilution of precision
A unitless figure of merit expressing the relationship between the error in user position and the error in satellite position, which is a function of the configuration of satellites from which signals are derived in positioning (see DOP). Geometrically, PDOP is proportional to 1 divided by the volume of the pyramid formed by lines running from the receiver to four observed satellites. Small values, such as "3", are good for positioning while higher values produce less accurate position solutions. Small PDOP is associated with widely separated satellites.

Point
A geographic feature derived from a vector requiring only one x,y coordinate pair.

Position
A geographic location on the earth, commonly measured in latitude and longitude or UTM. See Point.

Position Fix
The GPS receiver's computed position coordinates.

Post Processing
Correcting GPS field data for Selective Availability and other errors using a computer linked to a base station.

Position Fix
The GPS receiver's computed position coordinates.

Precise Positioning Service (PPS)
The highest level of military dynamic positioning accuracy provided by GPS, using the dual-frequency P-Ycode. See Precision Lightweight GPS Receiver (PLGR).

Precision Lightweight GPS Receiver (PLGR)
A hand held receiver used by the US military which incorporates Precise Positioning Service (PPS), and is unaffected by Selective Availability.

Pseudo-range
A distance measurement using uncorrected time comparisons from satellite transmitted code and the local receiver's reference code. The approximate calculated distances from a receiver to the satellites. These pseudo-ranges will correspond to the radio signal spheres surrounding the satellites. A distance measurement, based on the correlation of a satellite-transmitted code and the local receiver's reference code, that has not been corrected for errors in synchronization between the transmitter's clock and the receiver's clock.

Public Land Survey System (PLSS)
Commonly referred to as "Township and Range." A coordinate system emanating from a fixed "initial point," and forming an irregular rectangular grid of townships. Due to this irregularity, in which each township is essentially unique, and because of its limited regional use in the western US, PLSS is not used in GPS (coordinates must be converted to another system for use in GPS).

Route
A planned course of travel that is defined by a sequence of waypoints.

Satellite Constellation
The arrangement in space of a set of satellites. In the case of GPS, the fully operational constellation is composed of six orbital planes, each containing four or more satellites. GLONASS has three orbital planes containing eight satellites each.

Search The Sky
A message shown when a GPS receiver is gathering data from satellites to compute a position, without almanac data.

Selective Availability (S/A)
The random error (clock dithering) which the government intentionally adds to GPS signals so that their accuracy, for civilian use, is degraded. Clock dithering can be corrected by DGPS ground stations in real time, or data can be post corrected later in a computer. Selective Availability was "deactivated" by the Air Force in the spring of 2000. However, the U.S. military retains the option of reactivating S/A at any time without notice to non-military users.

Space segment
The portion of the GPS system that is comprised of more than 24 satellites orbiting the earth. (See Global Positioning System.)

Speed Over Ground (SOG)
The actual speed the GPS unit is moving over the ground. This may differ from airspeed or nautical speed due to such things as sea conditions or head winds. For example a plane that is going 120 knots into a 10 knot head wind may have a SOG of 110 knots.

Standard Positioning Service (SPS)
GPS information broadcast to everyone in the world. Affected by Selective Availability. The normal civilian positioning accuracy obtained by using the single frequency C/A code. Under selective availability conditions, guaranteed to be no worse than 100 meters 95 percent of the time.

Universal Time Coordinated (UTC)
A universal time standard, where time is measured globally as an offset from the time at Greenwich, England. Also referred to as Greenwich Mean Time (GMT), or Zulu time. UTC is an international, highly accurate and stable uniform atomic time system kept very close, by offsets, to the universal time corrected for seasonal variations in the earth's rotation rate. Maintained by the U.S. Naval Observatory, and other international organizations and observatories.

TracBack
A GARMIN GPS receiver feature which takes your current track log and converts it into an inverted route (last becomes first) of up to 30 waypoints to guide you back to a starting position.

Track (TRK)
Your current direction of travel relative to a ground position (same as COG). Also the projection on the surface of the earth of the present path of a vehicle, the direction of which at any point is expressed in degrees from North (true, magenetic, or grid).

True Heading
Direction of the person, vehicle, or receiver measured from true north.

True North
The direction of the North Pole from your current position. Magnetic compasses are slightly incorrect due to effects of the earth's magnetic field. GPS units are unaffected by magnetic influences, however they should not be relied upon for a high degree of accuracy.

Turn (TRN)
The degrees which must be added to or subtracted from the current heading to reach the course to the intended waypoint.

Universal Time Coordinated (UTC)
A universal time standard where time is measured globally as an offset from the time at Greenwich, England. Also referred to as GMT or Zulu time. UTC is an international, highly accurate, stable and uniform atomic time system kept very accurate by offsets to universal time, and corrected for seasonal variations in the earth's rotation rate. Maintained by the U.S. Naval Observatory, and other international organizations. GPS time is directly relatable to UTC: UTC-GPS = seconds. GPS Time was ahead of UTC by twelve seconds in 1999.

Universal Transverse Mercator (UTM)
A global coordinate projection system utilizing north and east distance measurements from reference point(s). UTM is one of the coordinate system used on United States Geological Survey topographic maps.

User segment
The part of the whole GPS system that includes the receivers of GPS signals.

Velocity Made Good (VMG)
The rate at which you are approaching a destination, based upon your current speed and course relative to that destination.

Waypoint
A permanently stored and named position in the GPS receiver's memory.

Wide Area Augmentation System (WAAS)
An enhanced positioning system that utilizes the Global Positioning System in conjunction with geosynchronous orbiting satellites and ground stations in the United States. Developed by the Federal Aviation Administration and Department of Transportation, WAAS covers only portions of North America.

WGS84
World Geodetic System 1984. The internal datum of the NAVSTAR GPS system. Very close to NAD83. The mathematical ellipsoid used by GPS since January, 1987. WGS84 is not found on any maps (NAD83 is used to approximate it in the U.S.). See World Geodetic System.

World Geodetic System (WGS)
A consistent set of parameters describing the size and shape of the Earth, the positions of a network of points with respect to the center of mass of the Earth, transformations from major geodetic datums, and the potential of the Earth (usually in terms of harmonic coefficients). WGS84 is the default datum used by NAVSTAR GPS. All positions and waypoints within a GPS receiver are calculated using WGS84. A receiver converts coordinates to the datum selected by the user.

Y Code
An encrypted P code when crypto-keys are loaded (installed); used by receivers to perform precise navigation calculations. The encrypted version of the P-code used by military and some government users in secure GPS receivers.